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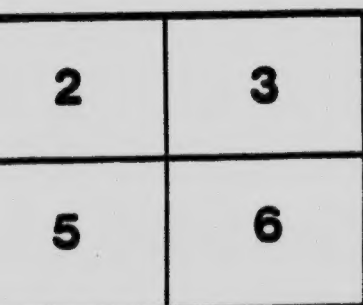
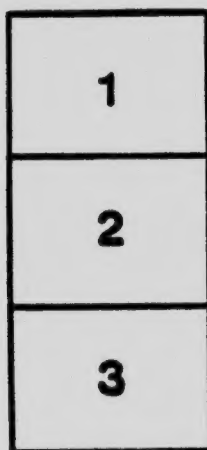
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INTENSIVE WORK IN
SCIENCE AT THE PUBLIC
SCHOOLS IN RELATION TO
THE MEDICAL CURRICULUM

BY

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INTENSIVE WORK IN SCIENCE AT THE PUBLIC SCHOOLS IN RE- LATION TO THE MEDICAL CUR- RICULUM.¹

By Sir WILLIAM OSLER, Bart., M.D., F.R.S.

Regius Professor of Medicine, Oxford.

FORTY and more years' experience with the finished article as turned out from your shops should give assurance of a knowledge on my part of your methods of work and endeavours. General impressions are rarely accurate, but it may be worth noting that a composite picture of the thousands of students who have left impressions on my mental films is one to be looked at with pleasure; and not without a feeling of gratitude to schoolmasters who have passed on so many men well fitted to study medicine. I do not say well prepared, but 99 per cent. have possessed the essential factor in a successful education, interest, a living interest in the subject. I am taking advantage of the honour you have conferred to urge that by a more intensive method of the study of the sciences,

¹ Presidential address delivered to the Association of Public School Science Masters on January 4th, 1916.

boys designed for the medical profession may leave your hands prepared to begin their special studies.

In a presidential address, and to this audience, a preliminary reminiscent note may be pardoned. As a boy I had the common experience of fifty years ago—teachers whose sole object was to spoon-feed classes, not with the classics, but with syntax and prosody, forcing our empty wits, as Milton says, to compose “Theams Verses and Orations,” wrung from poor striplings like blood from the nose, with the result that we loathed Xenophon and his ten thousand, Homer was an abomination, while Livy and Cicero were names and tasks. Ten years with really able Trinity College, Dublin, and Oxford teachers left me with no more real knowledge of Greek and Latin than of Chinese, and without the free use of the languages as keys to great literatures. Imagine the delight of a boy of an inquisitive nature to meet a man who cared nothing about words, but who knew about things—who knew the stars in their courses, and could tell us their names, whose delight was in the woods in springtime, who told us about the frog-spawn and the caddis worms, and who read to us in the evenings Gilbert White and Kingsley’s “Glaucus,” who showed us with the micro-

² Rev. W. A. Johnson, Founder and Warden of Trinity College School Canada.

scope the marvels in a drop of dirty pond water, and who on Saturday excursions up the river could talk of the Trilobites and the Orthoceratites, and explain the formation of the earth's crust. No more dry husks for me after such a diet, and early in my college life I kicked over the traces and exchanged the classics with "divers" as represented by Pearson, Browne, and Hooker, for Hunter, Lyell, and Huxley. From the study of nature to the study of man was an easy step. My experience was that of thousands, yet, as I remember, we were athirst for good literature. What a delight it would have been to have had Chapman's "Odyssey" read to us, or Plato's "Phædo," on a Sunday evening, or the "Vera Historia." What a tragedy to climb Parnassus in a fog! How I have cursed the memory of Protagoras since finding that he introduced grammar into the curriculum, and forged the fetters which chained generations of schoolboys in the cold formalism of words. How different now that Montaigne and Milton and Locke and Petty have come to their own, and are recognised as men of sense in the matter of the training of youth.

I wonder how many of you have a first-hand knowledge of these great masters in your Israel. For a man who, as Montaigne says, has only nibbled upon the outer crust of knowledge in his nonage, and has only retained a

general and formless image, it smacks of impertinence to offer idle whimsies to a group of experts. I have a mental reflex when I meet a young man engaged in teaching, and almost involuntarily out come the questions: Have you read Milton's "Tractate"? Do you know Locke's "Thoughts"? Have you ever tried a boy on Montaigne's classical diet? What do you think of Petty's "Ergastula Literaria"? I know what he thinks of me at the close of a few minutes' conversation! But seriously, who does not envy the happy issue of the noble experiment in education made upon the person of the great essayist, whose influence may be seen in the contributions of Milton and Locke? I was glad to read a few months ago the strong tribute paid by Sir Henry Morris (*Lancet*, September 18th, 1915) to these two great English reformers.

May I for a moment in passing say a word or two about the fourth, Sir William Petty, whose "*Advice . . . to Mr. Samuel Hartlib for the advancement of some particular parts of learning*" touches us very closely to-day. It is interesting that it should have been addressed to the man—himself a great educational reformer—at whose request Milton published his "Tractate." When written, the country was in the midst of civil turmoil, with a larger proportion of the population fighting than at any period in its history until the

present. The Universities were deserted, education neglected, and upon the old soil thus upturned Petty scattered the seed—to fall among thorns. Only in our day we have seen his three far-seeing propositions realised. Many of our schools are *ergastula literaria*, literary workshops, “where,” as he says, “children may be taught to do something towards their living as well as to read and write”; and he was keen that the children of the better classes be taught some “genteel manufacture in their minority,” and a delightful list is given. His *Gymnasium mechanicum*, or College of Tradesmen, is represented by our technical schools. Petty’s fertile mechanical genius foresaw the enormous advantage of such institutions in stimulating trades and inventions. “What experiments,” he says, “and stuffs would all these shops and operations afford for active and philosophical heads.” And what a wonderful design is his third institution—a *Nosocomium academicum*,* “a hospital to cure the infirmities both of Physicians and patients,” a great scientific school for the study of disease and its cure.” Neither Montaigne nor Milton nor Locke had the wide national outlook on education displayed by Petty, who alone almost of his generation realised that the problems of natural philosophy, as it was then called, must be attacked in a systematic and co-operative

study by a group of men "as careful to advance the arts as the Jesuits are to propagate their religion." One cannot but regret that the Professor of Anatomy at Oxford, and the Vice-Principal of Brasenose College, should have been diverted to a turbulent and disheartening career in Ireland, and to-day the identity of the founder of English political economy and of public health statistics is merged in the author of the *Down Survey*, and the *Beginner*—to use Fuller's word—of a great family³ (Lansdowne).

To come now to the subject-matter of my address—the earlier and more intensive study of science at school to save time at the university.

For fifteen years the slowly evolving sprightly race of boy should dwell in a Garden of Eden, such as that depicted by the poet—no sense of any ills to come, no care beyond the day, buxom health, wild wit, the sunshine of the breast, the lively cheer—

The thoughtless day, the easy night,
The spirits pure, the slumbers light.

During this blissful period a boy is an irresponsible yet responsive creature, a mental and moral chameleon taking the colour of his environment, very difficult to understand, often

³ Petty's "Advice" appeared in 1648 (4to, Lond.), and is also in vol. vi. of the "Harleian Miscellany." I hope to see this remarkable contribution to educational methods reprinted.

never understood by parent or teacher—yet, tied about his neck is a *clavis symphonia* with which anyone may unlock his heart and control his life. Rather an ideal sketch you may think, and doubtless Plato's description fits better with your experience—"and of all animals the boy is the most unmanageable, in so much as he has had the fountains of reason in himself not yet regulated; he is the most insidious, sharp-witted, and insubordinate of animals." What concerns us to-day is that about the fifteenth year there comes a change in this mysterious being—physical, mental, and moral. Consciousness that he is a man and has man's duties is forced upon him, and repeating the tragedy of the Garden, he awakens to the knowledge of good and evil. It is fitting to mark this change with a change in his education. Plato did it. Following two three-year periods devoted to general and humane studies came the maturer pursuits fitting the young citizen for service in the State. My plea is to follow this plan, as for one profession at least it is most desirable.

At fifteen a boy should have had sufficient general education—the three R's, a fair knowledge of the history and literature of his country, and in the public schools enough classics to begin a technical training and to pass the ordinary entrance examination. Now comes the fateful period in which the bent of

the boy's mind is determined. A difficulty exists in only a small proportion; a large majority have already selected careers, and the work of the sixteenth and seventeenth years should be determined by this choice, whether professional, commercial, academic, or the Services. The classical, modern, and scientific departments of the schools now meet these demands.

The profession of which I can speak is in a serious quandary. With the rapid development of science the subjects of study have become so multiplied that the curriculum is overburdened, and the five years is found to be insufficient. Men come up later, remain longer, and the twenty-fifth or twenty-seventh year is reached before the qualification to practise is obtained. A measure of relief to this heavy burden—and it is one not likely to lighten during the next decade—is in your hands. Devote the sixteenth and seventeenth years to the preliminary sciences—physics, chemistry, and biology—and send us at eighteen men fit to proceed at once with physiological chemistry, physiology, and anatomy.

To do this three things are needed: teachers, laboratories, and a systematic organisation of the courses.

I put the *personnel* first, as the man is more important than his workshop. Your society indicates the position which the science master

has reached in our public schools, not without long years of struggle. The glamour of the classics lingers, but the shock which the nation has had in this great war will make us realise in the future that to keep in the van we must be in the van intellectually in all that relates to man's control of nature. Science "Heads" at Winchester, Eton, and Harrow would give the death-blow to the old-time Anglican tradition so well expressed in a Christmas sermon by the late Dean Gaisford, that classical learning "not only elevates above the vulgar herd, but leads not infrequently to positions of considerable emolument." There is an initial difficulty apt to block good men, the fear of overburdened teaching, since it is not always possible for a school to pay an adequate staff; but the past twenty years have seen the whole situation changed. The posts have become more and more attractive and better paid, so that a definite career is now offered to able young men. Many original contributions to science made by the members have given a proper *caché* to the association, and, I may say, have added enormously to its intellectual status. Men feel proud to have as colleagues distinguished workers. Let us not forget that Priestley got his F.R.S. while a master at the Warrington Academy. The exhibits by members at this meeting indicate a fertility of invention in the highest degree creditable.

Brains, not bricks, should be the school motto in the matter of laboratories. A young Faraday in a shed is worth a dozen scientific showmen in costly buildings with lavish outfits. The accommodation, I am told, is at present ample in the larger schools. I have, indeed, seen laboratories which the most up-to-date college would envy. In the smaller schools it has not always been easy to get either the men, the space, or the equipment for teaching all the branches, and if an attempt is made to give earlier and more intensive science teaching there will have to be improvement all round.

The real crux is not with men or with buildings, but so to organise the teaching of the school as to have a continuous science course through two years. What is done now occasionally by the individual, I should like to see done by all the science men coming up to the universities or to the medical schools. A few men take the preliminary scientific subjects on entering Cambridge. Though possible, this at Oxford is rarely done; indeed, the examination is not at a suitable time! For some years now I have watched the results of the chemistry "prelims" at Oxford, and have consulted with many examiners, and I am sorry to say that the opinion usually expressed has been that in this subject the teaching in the schools is not yet up to college standards.

Here is where my appeal comes to the school authorities. Give us the boys of the sixteenth and seventeenth years for well-organised thorough courses in biology, chemistry, physics, and the associated mathematics. You have the teachers and the "plant." Think what could be done with a class of bright boys in two full years, who had *nothing else to do*. No, I would let them have two other subjects, French and German, taught *à la Montaigne*, by making the boys use elementary French and German text-books. Wit., reading clubs, Selborne clubs, and historical clubs, conducted by the boys themselves in the laboratories, the literary side of their education would be continued, and a sympathetic teacher would not be above putting a little English polish on, say, a short essay on Lavoisier. Judiciously mixed, chemistry through two years, biology through two, and physics in one—how I envy the teachers, how I envy the taught! A full year would be gained, as the two spent at the school in science would be the equivalent of the one now spent upon the preliminary subjects after entering the medical school. It would indeed be possible to allow those who came up to a certain standard to cut off the fifth year. By shortening vacations, and rearranging methods of instruction, we could return to a four-year curriculum. Practically that is what it is

now, as a majority of men spend the first year in preliminary sciences, to teach which is really no business of the medical schools. With this arrangement the average man could qualify at twenty-two years of age, spend a year in hospital or at post-graduate study, and start in "life" at twenty-three. We are now losing valuable time and wasting much needed money. What a present to make to our young men—two full years! It is worth while; and it can be done, and should be done.

My colleague, Prof. Arthur Thomson, has suggested that during the present emergency special arrangements should be made to pass on the boys at an earlier age, with their chemistry and physics well in hand. The plan I urge would make a radical change in the constitution of some schools. Not that science is not taught and we're taught, but it should be given its proper place, as the dominant partner in the educational family, not a Cinderella left in the kitchen. From an intellectual standpoint the advantages are obvious. The mental exercise of the physical and mathematical sciences, combined with the technical training in the use of apparatus, gives a type of education singularly stimulating to boys. How many of our great inventors have lamented colourless careers at school! Things, not words, appeal to most boys. What an evolution of mind and hand is wrought by

a year in a well-conducted physical laboratory. The fascination of making and fitting the apparatus, the wonders of electricity, and the marvellous laws of heat and light—into this new and delightful world a boy of sixteen may pass safely for a thorough training. Only it must not be a mere dabbling, to which the physical laboratory too often lends itself, but a serious day by day, week by week, gradual progress. The senior boys could keep their knowledge of the subject fresh by acting as demonstrators in the junior classes. Many lads show an extraordinary aptitude for physics; there is always a boy Pascal in a big school, and no subject is so suited to arouse a fervid devotion to science. It would do the nation great good to have each generation, at the sixteenth or seventeenth year, pass automatically through a laboratory of physics.

I have spoken of the doubts expressed whether chemistry in the public schools can be taught at a college level. Of course it cannot as a subsidiary subject, to which only a few hours a week are devoted, but in a course extending over two years, as a major subject, with laboratory work four or five mornings a week, surely a youth in his sixteenth and seventeenth years should be able to put in the foundation stones, and in individual cases it is done already. As a mental discipline chemistry almost rivals physics; indeed, the

new physical chemistry is a blend which appeals with magic potency to all science students.

But no subject attracts the young mind so strongly as biology, in its varied aspects. Elementary teaching is now admirably arranged, and in a two-year curriculum it should be an easy matter to cover much more ground than in the preliminaries demanded for medicine. Field classes in botany, gardens, museum work, should all be utilised. I would like to see at every school that excellent plan adopted by the late Sir Jonathan Hutchinson at his village museum, Haslemere—nature lectures on Sunday afternoons, with exhibition of the flowering plants of the season, with any other specimens of interest. The biology class gives an opportunity of a clear statement of the facts of sex, always so hard to discuss with boys.

There are objections, of course, to extensive and intensive teaching of science in schools. It is the business of the college, not of the school, to prepare boys for technical studies; but if it is the business of the school to teach science at all, why not teach it thoroughly? The general influence of the school may be trusted to counteract the evil possible in a too early concentration upon special subjects. Nature is never special, and a knowledge of her laws may form a sound Grecian founda-

tion upon which to build the superstructure of a life as useful to the State, and as satisfying to the inner needs of a man, as if the ground-work were classics and literature. The two, indeed, cannot be separated. What naturalist is uninfluenced by Aristotle, what physician worthy of the name, whether he knows it or not, is without the spirit of Hippocrates. It has been well said that instruction is the least part of education. Upon the life, not the lips, of the master is the character of the boy moulded; and doubtless the great master of masters had this in mind when he said: "It may be, in short, that the possession of all the sciences, if unaccompanied by knowledge of the best, will more often than not injure the possessor." (Plato, "Alcibiades," ii.)

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